

Original Article

Functional Outcome of Tibial Nonunion Treatment by Ilizarov Fixator

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Objective: To evaluate the functional outcome of limb operated with the Ilizarov fixator according to Modified Functional Evaluation System by Karlstrom-Olerud.

SETTING: Orthopedic Department of Pakistan Institute of Medical Sciences (PIMS), G-8/3, Islamabad, Pakistan.

STUDY DESIGN: Descriptive case series.

SUBJECTS AND METHODS: In this two years study, 45 cases of post traumatic aseptic nonunion of tibia were included. Postoperative mean follow up was 280 days (180-330 days).

RESULTS: Out of 45 patients, 41 (91.1%) were male and 4 (8.9%) were female. Our 15 patients (33.33 %), with Paley type A nonunion (Group 1) were treated by compression. While 30 cases (66.67 %), comprising of Paley type B-2 and B-3 requiring bone transport, were placed in Group 2. Bone union was achieved in 41 (91.11%) cases. Clinical results were good in 16 (35.56 %), satisfactory in 10 (22.20 %), moderate in 13 (28.89 %) and poor in 6 (13.33 %) patients. The most common recorded complication was pin tract infection.

CONCLUSION: The Ilizarov method is a reliable tool for treating tibial nonunion towards successful functional outcome. Functional outcome is more important than perfect anatomy.

Keywords: Tibia, tibial bone defect, Ilizarov technique, bone lengthening

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Introduction

Tibia, as subcutaneous bone, is more exposed to fractures which are often complex and may result in nonunion. Tibial nonunion ranges from 2-10% of all tibia fractures¹. The Ilizarov fixator helps option of compression, distraction, control over angular and rotational deformities, and bone transport along with soft tissue transport, avoiding leg length discrepancy. However, only few centers in Pakistan are using this technique. Paley's classification of Tibial nonunion is helpful in treatment with Ilizarov Fixator. Treatment options are intramedullary nail, dynamic compression plate (DCP), bone grafting, vascularized fibular graft, electric stimulation, and bone transport. In complex nonunion, intramedullary nailing is preferred in delayed consolidation and hypertrophic nonunion without angular defects or hypometria, while the Ilizarov method is more indicated in atrophic nonunion and in hypertrophic nonunion with hypometria and angular defects².

The literature shows that delayed treatment, thin soft tissue envelope below the knee joint, high-energy trauma, unfavorable blood supply, and complex fracture patterns contribute to the unfavorable outcomes in tibial

nonunion³. The patients, who they are well explained, are better prepared for treatment⁴.

In all the studies of tibial nonunion treated with the Ilizarov fixators in Pakistan, the results are based on ASAMI (Association for the Study and Application of the Method of Ilizarov) criteria. In ASAMI criteria, the functional results are inferior to the bone results in most of the studies. Radiological union does not mean full function, as residual weakness, pain, and limitations in function are common at the end of treatment.

Materials and Methods

It was a 24 months study from 25 March 2009 to 24 March 2011, conducted in Orthopedic Department of Pakistan Institute of Medical Sciences (PIMS), G-8/3, Islamabad. After approval from hospital ethical committee, 45 patients with post traumatic aseptic nonunion of tibia were enrolled. The patients of either gender with age 13-50 years, having nonunion (aseptic nonunion) in tibia with defect up to 10 cm due to trauma were included in the study. The patients with history of rheumatoid arthritis, known case of peripheral vascular disease, diabetic patient, other limb fracture and defect more than 10 cm were excluded from study. 45 patients with established tibial nonunion, fulfilling the inclusion

and exclusion criteria, were documented clean, based on clinical findings along with normal ESR and CRP levels. All the patients were operated upon by the same surgeon with the same technique (The Ilizarov Technique).

Gentle exercises in limit of comfort were started, immediate postoperatively. Partial weight bearing on first postoperative day and bone transport at rate of 0.25 mm / 6 hourly daily (1 mm per day) started on 10th post-operative day. After fixator removal, PTB brace was given for 4 weeks and at least four weeks physiotherapy was done before final functional scoring with Modified Functional Evaluation System by Karlstrom-Olerud³ as given in Table 1 and 2.

Table 1. Modified Functional Evaluation System by Karlstrom-Olerud

Sr. No.	Measures	3 points	2 points	1 point
1	Pain	No	Little	Severe
2	Difficulty in walking	No	Moderate	Severe Limp
3	Difficulty in stairs	No	Supported	Unable
4	Difficulty in previous sports	No	Some sports	Unable
5	Limitation at work	No	Moderate	Unable
6	Status of skin	Normal	Various colors	Ulcer /Fistula
7	Deformity	No	Little, up to 7°	Remarkable, >7°
8	Muscle atrophy	< 1 cm	1-2 cm	>2 cm
9	Shorter lower extremity	< 1 cm	1-2cm	>2 cm
10	Loss of motion at knee joint	< 10°	10-20°	>20°
11	Loss of Subtalar motion	< 10°	10-20°	>20°

Table II. Final Scoring system (Modified Functional Evaluation System by Karlstrom-Olerud)

Excellent	33 Points
Good	32-30 Points
Satisfactory	29-27 Points
Moderate	26-24 Points
Poor	23-21 Points

STATISTICAL ANALYSIS At the completion of study, descriptive statistics calculated including mean $\pm$ SD for quantitative variables like, age, period of nonunion, in fixator time and union time using SPSS version 11. Frequencies and percentages were calculated by using chi square test. Graphical representation for qualitative variables i.e. gender, mechanism of injury, side involved, and final outcome.

Results

Out of 45 patients, 41 (91.1%) were male and 4 (8.9%) were female. Average age was 36.26 years (Range 14 – 50 years). 15 patients (33.33 %), with Paley type A nonunion (Group 1) were treated by compression. While 30 cases (66.67 %), comprising of Paley type B-2 and B-3, requiring bone transport, were placed in Group 2. Bone union was achieved in 41 (91.11%) cases with union time given as in Figure 1.

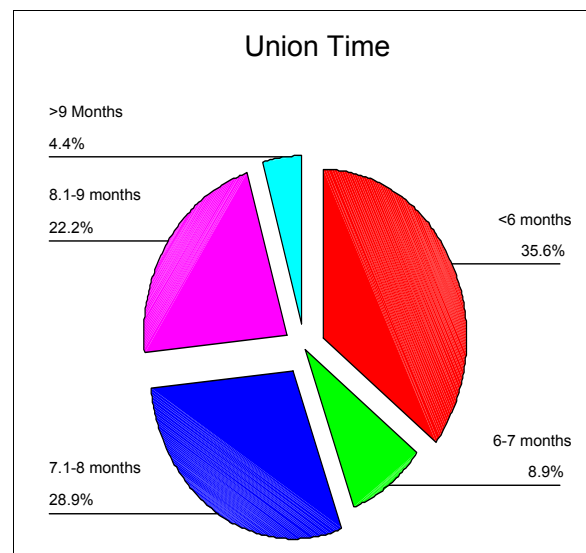


Figure 1. Bone Union Time

Left tibia was involved in 29 (64.4%) patients, right tibia in 16 (35.6%). 8 patients (17.8%) had proximal 1/3rd of tibia as site of nonunion, 28 patients (62.2%) had middle 1/3rd and 9 patients (20%) had distal 1/3rd of tibia. 25 patients (55.6%) were victim of road traffic accidents. All the patients were operated in the past. 21 (47 %) patients had single surgery in the past, 10 patients

(22%) had 2 surgeries, and 8 patients (18%) had 3 surgeries while six patients (13%) had 4 surgical procedures in the past. The average duration of nonunion was 22.29 months. 15 patients had bone defect up to 2 cm. Bone defect 2.1 -3 cm was found in 6 patients. 22 patients had bone defect of 3.1-4 cm, while 2 patients had defect more than 4 cm. So, there were two types of patients: 15 patients with defect up to 2 cm were treated by compression only (Group 1) and 30 patients with bone defect > 2 cm required bone transport (Group 2). 16 patients (35.6%) remained in the Ilizarov ring external fixator for less than 5 months, 6 (13.35) patients remained in fixator for 5-6 months, 20 patients (44.4%) for 6-7 months and in only one patient for more than 8 months. Our results were excellent in zero, good in 16 (35.56 %), satisfactory in 10 (22.2 %), moderate in 13 (28.89 %) and poor in 6 (13.33 %) patients. Most common complication was pin tract infection.

Discussion

The decision to intervene in order to promote fracture healing and/or realign the fracture may be influenced in the presence of varying definitions of nonunion and malunion⁵. Apart from use of Ilizarov fixator in pediatrics, some studies in elderly patients treated with this device have highlighted good functional results. This study is unique with respect to role of Ilizarov in aseptic tibial nonunion, measured in terms of functional outcome. The ASAMI criteria defines unemployment as poor result⁶. Majority of our patients were able to join their previous work but with less demanding job. Other studies have highlighted that patient satisfaction is more important than the employment status in functional status assessment. This is true in case of developing countries like Pakistan, where no financial support system exists for the unemployed. Previous studies have pointed out that ASAMI criteria may not be applicable for functional evaluation in such society⁷. In our series, the final outcome was measured according to the Modified Functional Evaluation System by Karlstrom-Olerud (Table 2). In this study, the majority of the patient were candidates of secondary reconstruction for post traumatic nonunion.

The bone defect was calculated as previous defect plus amount of bone resected. The average bone defect was 3.07 cm, which is comparable to other reports^{8,9}. According to the Paley's classification, 15 patients (33.33 %) had type A and B-1 (defect up to 2 cm) nonunion¹⁰. These patients were treated by compression as was followed by Sen. C and Magadum MP^{11,12}. 30 cases (66.67 %), with defect more than 2 cm, Paley's type B-2 and Type B-3 required compression at nonunion site and distraction at corticotomy site.

The average in fixator time in our patients was 5.3 months (Range 2.30-10 months). Oztürkmen Y and Doğrul C mentioned that in their study, the average fixator time in monofocal application was 162 days (5.4 months) being similar to our results¹³.

The treatment goal could be achieved in 39 out of 45 patients. Initially, most of the patients had varying degree of equinus deformity, with ankle, subtalar, and knee stiffness. Majority of them was able to resolve the knee stiffness with the help of physiotherapy, which was well emphasized throughout the course of treatment.

According to final scoring, the results were good in 16 (35.56 %), satisfactory in 10 (22.2 %), moderate in 13 (28.89) and poor in 6 (13.33 %) patients. No excellent results were obtained. We can compare these results with previous studies, with the similar criteria, in literature; Oçgüder DA treated 33 patients, with no excellent outcome¹⁴. However, 42.4 % were good, satisfactory 33.3%, moderate 24.2 %, and no poor results. We attribute our poor results to our learning curve and poor patient compliance.

Most patients were from low socio-economic class and were uneducated. Similarly, in another study in 2007 by Ball Point and Tezeren D with 10 patients¹⁵, the results were; good 40 %, satisfactory 20%, moderate 30%, and poor 10 %. Their poor results are related to the small sample size.

Most common variables affecting our results were skin color changes, little deformities, shortening up to 2 cm, loss of subtalar motion < 20° and supportive environment at previous job.

In our series, a 40 years old male patient was a victim of RTA. This patient had right tibial nonunion for last 18 months (Figures 3-A - 3D). Distal third of tibia was the site of nonunion as shown in Figure 3-A. There was a bone defect of 1.7 cm, and it was classified as Paley's type B-1 nonunion. This patient was applied with Ilizarov fixator by compression technique along with partial fibulectomy (Figure 3-B). The fixation time was 2.7 months, followed by 4 weeks PTB. The bone united at 3.7 months (Figure 3-C). PTB was removed; it was followed by physiotherapy course of 4 weeks. At the end of follow up for 4.7 months, he had skin of various colors as shown in Figure 3-D, and on x-ray examination, there was posterolateral angulation in range of little deformity. He had shortening of 1.5 cm, and loss of subtalar range of motion was 15 degrees. He had difficulty in some of the previous sports and was in need of some supportive environment at previous job. The patient was evaluated for final outcome according to Modified Functional Evaluation System by Karlstrom-Olerud. He had 27 score with satisfactory outcome.

Most common complication in our study was pin tract infection (35.6%) followed by loss of subtalar motion (20%). All these local complications in our series were similar to those in most of the relevant literature¹³.



Figure. 2 A patient from our study treated with Ilizarov Ring Fixator. 3-A) Pre-op X-rays, 3-B) In fixator, 3-C) Final X-rays, 3-D) Knee ROM

Conclusion

The delayed treatment, thin soft tissue envelope below the knee joint, high-energy trauma, unfavorable blood supply, and complex fracture patterns contribute to the unfavorable outcomes in tibial nonunion. Our results show that the Ilizarov external fixator is a valuable tool in the management of post traumatic aseptic tibial nonunion. This is important for the developing countries where facilities for close IM nailing and plastic surgery are not always present. Besides, with its well known usefulness in infected nonunions, it is a good choice of treatment in aseptic tibial nonunion, complex deformities and significant limb length inequalities.

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